Using the Borg CR10 Physical Exertion Scale to Measure Patient-perceived Vocal Effort Pre and Post Treatment

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Summary: Objectives. Reduction of vocal effort is a therapeutic goal in resonant voice therapy and in the treatment of a variety of voice disorders. The Borg CR10 is a perceived effort scale that is widely accepted across a wide variety of disciplines. The purpose of the present study was to examine (1) the utility of an anchored, adapted Borg CR10 in observing treatment-related vocal effort reduction and (2) the convergent validity of the Borg CR10 in its relation to Voice Handicap Index (VHI) item 14.

Study Design. This is a pretest-posttest experimental design.

Methods. A total of 36 individuals with phonotraumatic hyperfunctional voice disorders completed item 14 of the VHI and the Borg CR10 at the start and completion of four sessions of resonant voice therapy treatment.

Results. Scores from the Borg CR10 significantly differentiated pre- from post-therapy perceived effort levels. Convergent validity was demonstrated through significant associations with scores from item 14 of the VHI.

Conclusion. The anchored Borg CR10 is an easy to use clinical tool to capture treatment-related vocal effort reduction. Whereas VHI item 14 indicates how frequently increased perceived effort is experienced, the Borg CR10 captures the severity of perceived effort used. Thus, the two measures complement each other.

Key Words: Voice therapy–Voice disorders–Vocal effort–Borg CR10–Voice outcome measurement.

INTRODUCTION

One of the common and characteristic symptoms of a voice disorder is the patient's perception of increased effort or strain in voicing,[1] otherwise known as perceived phonatory effort or exertion.[2,3] Numerous medical conditions can theoretically contribute to the need to increase exertion in the phonatory system. Vocal fold edema or mass lesions require increased respiratory drive, as does glottal incompetence associated with unilateral vocal fold paralysis.[4–7] These can therefore translate into the patient's perception of increased effort. Increased vocal effort or strain can also be behavioral in nature and potentially result in trauma as a result of excessive adductory collision forces observed in some behaviorally acquired voice disorders termed "adducted hyperfunction"[7] or, synonymously, "phonotraumatic hyperfunction."[8] Because of this, the reduction of vocal effort is often targeted through behavioral voice therapy.[9–13] Unfortunately, physiological measurement such as phonation threshold pressure or visual observation of the vocal folds do not comprehensively capture this common complaint, and attempts to measure patients' perception of vocal effort have remained incomplete.[2,3] Thus, a meaningful measurement tool of perceived vocal effort has not been established for clinical use.

One measure of vocal effort that has been investigated for clinical utility is the Borg CR10.[14,15] Given that the Borg CR10 scale has effectively tracked vocal effort in past research protocols,[3,16–18] it may be a promising tool to employ clinically. Additionally, this scale is of interest because of its extensive and successful measurement of perceived exertion or effort in the kinesiology, medical, and ergonomic fields.[19–26] Particular strengths include its usability for the lay person, its response format, and its construction as a numeric ratio with standard intervals and true zero point,[3] as well as categorical verbal descriptors of each numeric point (eg, "light," "moderate," or "heavy" exertion).

The Borg CR10 also proved promising in differentiating a population with voice disorder from a healthy population in an investigation of its clinical utility completed by Baldner et al.[3] Individuals with voice disorders rated their vocal effort level higher than vocally healthy individuals for a variety of quiet and normal loudness vocal tasks. In conversation, the average score for perceived effort in participants with voice disorders was 1.48 (standard deviation [SD] 1.81) (SD = .95), whereas it was 1.41 (SD = .95) for healthy controls. However, this difference was not statistically significant. Because the participants with voice disorders in Baldner et al's study were known to have significantly elevated vocal effort (ie, strain, phonotraumatic voice use, complaint of effortful voice production) compared with vocally healthy participants, the study represented a "known-groups[27] validity test" of the Borg CR10. A valid measure of vocal effort should be able to detect known-group differences. Baldner et al considered that the instrument's verbal descriptors ranging from "very, very light" effort to "maximal" effort may not have been meaningful without links to concrete tasks such as quiet confidential conversation versus yelling over noise at a ball game. The authors suggested that more investigation into varying the elicitation tasks, anchoring the responses, and standardizing the instructions could improve the clinical utility of the Borg CR10. Therefore, a study involving clinical application of the Borg CR10 should involve methods (ie, elicitation tasks, anchors, and instruction) that improve the ability to detect known differences.

In the present study, we investigate the Borg CR10's potential as outcome measure of perceived vocal effort in voice therapy.

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The instrument's validity is examined by (1) testing its ability to detect known pre- and post-therapy vocal effort differences and (2) quantifying its association with another measure of perceived vocal effort: Voice Handicap Index (VHI)[28] item 14 ("I feel as though I have to strain to produce voice."). The former approach can be considered a variation on known-groups validity testing, whereas the latter exemplifies convergent validity[27] testing. Given the aim to examine Borg CR10's appropriateness as outcome measure, the investigation is entirely in the context of voice treatment and the within-group differences that represent progress in therapy.

The study population and the implementation of resonant voice therapy are particularly appropriate to the aim because (1) phonotraumatic voice production is characterized by increased vocal effort[7]; (2) resonant voice therapy directly reduces hyperfunctional adduction and associated perceived vocal effort[29,30]; and (3) post-therapy improvement signifies, at least in part, a reduction in vocal effort.[9,29,31] Data were collected as part of a larger treatment research study of patient adherence (ie, compliance), such that extensive outcome measures documented pre and post therapy differences.[32]

Convergent validity testing was possible through participants' completion of VHI item 14: "I feel as though I have to strain to produce voice." As both this item and the Borg CR10 assess perceived vocal effort, the two measures should yield a significant statistical association. However, because VHI item 14 asks users to rate the *frequency* of effortful voice use, whereas the Borg CR10 measures the *severity* of effort, the association is unlikely to be perfect.

In the present study, implementation of the Borg CR10 scale differs from its use in the previous two studies[3,16] by incorporating experiential anchoring to clarify scale end points. The ecological validity of effort scales can be improved by using *experiential anchoring* of the scale end points: zero effort and maximal effort.[33] Specifically, experiential anchoring methods can include exercise and memory anchoring.[33] When employing exercise anchoring, the user completes a given exercise that is indicative of the end point effort level on the scale, thus experientially anchoring that point. In the present study, the 0 end point (ie, no perceived vocal effort) was anchored with the exercise of effortless resonant voice production. To anchor the maximum scale end point (10), we used memory rather than exercises anchoring to avoid phonotrauma that could be associated with maximal vocal effort production. Memory anchoring is achieved by asking the user to recall a specific effort level experienced in the past, then tying this experience to an end point. Recollection of attempting to talk during severe laryngitis was used to anchor the maximal effort end point of "10."

Purpose of the study

The purpose of this study was twofold: (1) to examine whether an experientially anchored Borg CR10 scale value could detect treatment-related changes in patient-perceived vocal effort. We hypothesized that Borg CR10 scores would be significantly higher at the start of treatment than at the completion of four sessions; and (2) to examine convergent validity of the Borg CR10 by quantifying the relationship between the Borg CR10 and an easily recognized clinical effort rating: VHI item 14 ("I feel as though I have to strain to produce voice"). We hypothesized that the two instruments would be significantly, but not perfectly, associated both pre and post therapy.

To accomplish these goals, we examined pre- and post-therapy Borg CR10 and VHI item 14 scores in a clinical population of individuals with phonotraumatic hyperfunction who had successfully completed four sessions of voice therapy, with significant improvements on traditional outcome measures. Pre- and post-therapy data collection included completion of the Borg CR10 and the VHI, yielding the dataset analyzed in the present study.

METHODS

Participants

Thirty-six adults aged 21–64 years participated in a larger institutional review board–approved treatment study at the University of Wisconsin Voice and Swallow Clinic.[24] The group included 26 women aged 21–62 years (M = 40.08, SD = 13.43) and 10 men aged 21–64 years (M = 45.3, SD = 14.59). Vocal fold status and vocal function were determined *via* team approach evaluation by the providing speech-language pathologist and laryngologist. Complete patient demographics and vocal fold pathologies for 35 of the participants can be found in the study by van Leer and Connor.[34] All participants presented with visual confirmation of increased medial compression on stroboscopy. Additionally, participants demonstrated initial success in diagnostic therapy probes for resonant voice therapy. In all cases, treatment was rated as successful to some degree, as indicated by significant improvement in outcome measures, including significant reduction in VHI scores and Consensus Auditory-Perceptual Evaluation of Voice ratings, significant increase in self-reported use of resonant voice, and significant increase in self-efficacy for resonant voice production.

Treatment

As part of a larger study on therapy compliance, participants received 4-hour-long treatment sessions of resonant voice therapy, each spaced 1 week apart. Although some participants continued to receive therapy service after the study completion, pre- and post-therapy measures were taken before and after four sessions to maximize the consistency of the temporal course of therapy. In this manuscript, the term "post therapy" is used to denote "after four sessions of therapy." The therapy protocol was based on Lessac-Madsen Resonant Voice Therapy,[9,30,35] and provided by clinicians who had completed a Lessac-Madsen Resonant Voice Therapy workshop by Dr. Verdolini. The aim of this program is to develop "resonant" voice, defined as voice production associated with patient-perceived lack of effort at the laryngeal level ("ease") and a sensation of vibration in the oral cavity[30,35]; resonant voice production is associated with reduced laryngeal adduction.[29]

Measures

The VHI and the Borg CR10 were administered at the first and fourth (ie, final) therapy sessions associated with the study. Par-